LIME

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In 2004, the U.S. lime industry experienced another busy year as strong demand from the steel and utility power industries resulted in increased lime consumption. U.S. production of lime was more than 20.0 million metric tons (Mt) (22.0 million short tons) with a value of $1.37 billion (table 1). Production increased by 843,000 metric tons (t) (929,000 short tons) compared with 2003.

The term lime as used throughout this chapter refers primarily to six chemicals produced by the calcination of high-purity calcitic or dolomitic limestone followed by hydration where necessary. There are two high-calcium forms—high-calcium quicklime (calcium oxide, CaO) and high-calcium hydrated lime [calcium hydroxide, $Ca(OH)_2$]. There are four dolomitic forms—dolomitic quicklime (CaO•MgO), dolomitic hydrate type N [$Ca(OH)_2$•MgO], dolomitic hydrate type S [$Ca(OH)_2$•$Mg(OH)_2$], and refractory dead-burned dolomite (CaO•MgO). Lime also can be produced from a variety of calcareous materials, such as aragonite, chalk, coral, marble, and shell. It also is regenerated (produced as a byproduct) by paper mills, carbide plants, and water-treatment plants. Regenerated lime, however, is beyond the scope of this report.

Production

Domestic production data for lime are derived by the U.S. Geological Survey (USGS) from a voluntary survey of U.S. operations. The survey is sent to primary producers of quicklime and hydrate, but not to independent hydrators that purchase quicklime for hydration, in order to avoid double counting. Quantity data are collected for 28 specific and general end uses, and value data are collected by type of lime, such as high-calcium or dolomitic. Because value data are not collected by end use, value data shown in table 4 are determined by calculating the average value per metric ton of quicklime sold or used for each respondent and then multiplying it by the quantity of quicklime that the respondent reported sold or used for each end use. The table lists the total quantity sold or used for an end use and the total value of the quicklime and hydrate sold or used for that end use calculated as described above. The same methodology is used to calculate the value of hydrate sold and used in table 5.

In 2004, of the 94 operations to which an annual survey form was sent, 1 was closed or idle all year, and of the remaining 93, 86 responded to the survey, representing 98% of the total sold or used by producers. Production data for the seven nonrespondents were estimated based on prior-year production figures and other information.

Lime is a basic chemical that was produced as quicklime at 89 plants in 32 States and Puerto Rico (table 2). At the end of 2004, hydrated lime was being produced at 12 separate hydrating facilities (including 2 plants where the kilns had been shut down and hydrate was manufactured from quicklime produced offsite). In a few States with no quicklime production, hydrating plants used quicklime shipped in from other States. There were also a small number of slurry plants where lime was converted to liquid form by the addition of water prior to sale; this is sometimes called milk-of-lime. States with production exceeding 2 Mt were, in descending order, Missouri, Kentucky, and Alabama; States with production between 1 and 2 Mt were, in descending order, Ohio, Texas, Pennsylvania, and Nevada.

Total lime sold or used by domestic producers in 2004 increased to more than 20 Mt, about 4% higher than in 2003. Production included the commercial sale or captive consumption of quicklime, hydrated lime, and dead-burned refractory dolomite. The bulk of increased production was in quicklime output, although small increases were also reported in the production of hydrated lime and dead-burned refractory lime. The production of high-calcium quicklime increased by nearly 2%, while dolomitic quicklime production increased by about 22%. Although total production of hydrate was essentially unchanged, high-calcium hydrate increased by 7.4%, and dolomitic hydrate decreased by 27.4%. Commercial sales increased by about 770,000 t (850,000 short tons) to about 18.5 Mt (20.4 million short tons), and captive consumption increased by 70,000 t (77,000 short tons) to 1.54 Mt (1.70 million short tons).

Oglebay Norton Co. (parent of lime and limestone producer Global Stone Corp.) filed for Chapter 11 bankruptcy protection in February 2004. The company initially announced plans to sell the lime operations of its Global Stone business, but subsequently decided to retain the lime operations. A U.S. bankruptcy court approved the company's reorganization plan in November 2004, and the company officially emerged from bankruptcy protection on January 31, 2005 (Oglebay Norton Co., 2005§[1]).

Carmeuse S.A. [Carmeuse North America's (CNA) Belgian parent] acquired the 40% stake in CNA previously held by France's Lafarge S.A. The 60-40 joint venture had been formed in 1999 when Carmeuse and Lafarge combined their North American lime operations (Industrial Minerals, 2005).

As part of phase II of its expansion program, United States Lime & Minerals, Inc. added a second large preheater rotary kiln to its Arkansas Lime unit in Batesville, AR, and finished rehabilitation of a distribution terminal in Shreveport, LA. In March, the company incorporated a new Texas subsidiary, U.S. Lime–Houston, to conduct lime slurry operations in the Houston area. In addition, the company announced that it entered into an oil and gas lease agreement with EOG Resources, Inc. on its Cleburne, TX, property where

[1]References that include a section mark (§) are found in the Internet References Cited section.

its Texas Lime Co. subsidiary is located. U.S. Lime received lease bonus payments totaling about $1.3 million and retained a royalty interest in any oil or gas production from the property (United States Lime & Minerals, Inc., 2005§).

In early 2004, Mississippi Lime added a large preheater rotary kiln to its Ste. Genevieve, MO, plant. Production from this new kiln replaced that of two of its Peerless plant straight rotaries, which were shut down. The Ste. Genevieve plant now operates 10 straight rotary kilns, a preheater rotary kiln, a vertical shaft parallel flow regenerative kiln, and a precipitated calcium carbonate plant.

Vessel Mineral Products Co. in Bonne Terre County, MO, restarted its lime plant in spring 2004. Vessel Mineral Products, a producer of dolomitic lime primarily for the steel market, had been shut down since March 2002. Production data for the Vessel plant were not included in the 2004 lime statistics because the USGS was unaware that the plant had restarted operations. In late 2004, Chemical Lime Co. restarted production at its Douglas, AZ, plant in response to increased copper production in Arizona. The plant had been idle since the end of 2001. USG Corp. closed its small lime plant in Louisiana; in the past, the plant had produced high-value lime products for specialty markets such as lubricating grease.

In 2003, the National Lime Association (NLA) signed an agreement with the U.S. Department of Energy to reduce voluntarily carbon dioxide emissions intensity by 8% between 2002 and 2012. It was understood that the lime industry cannot reduce emissions from the calcination of limestone, so the agreement focused on achieving energy-related reductions in emissions intensity (carbon dioxide emissions per ton of lime produced) (National Lime Association, 2003). In response to this agreement, in 2004, NLA members held discussions on a broad array of methods to reduce emissions of carbon dioxide from lime plants, including developing better energy management programs, examining fuel options, and enhancing the efficiency of various operations and equipment, including blasting, fuel grinding, motor/drive use, scrubbers and/or baghouses, and kilns (National Lime Association, 2004).

At yearend, the top 10 companies, in descending order of production, were Carmeuse Lime, Chemical Lime Co., Graymont Ltd., Mississippi Lime, Global Stone Corp., U.S. Lime & Minerals, Martin Marietta Magnesia Specialties LLC, Western Lime Corp., Ispat Inland Inc., and Southern Lime Co. These companies operated 44 lime plants and 8 separate hydrating plants and accounted for nearly 88% of the combined commercial sales of quicklime and hydrated lime and nearly 84% of total lime production.

Environment

In the United States, the lime industry produces large amounts of byproduct lime kiln dust (LKD), primarily from the operation of rotary kilns. At current production levels, the lime industry produced an estimated 3 Mt of LKD, which was collected by dust control systems to comply with air quality regulations. There are five types of control equipment that may be used individually or in complementary systems by lime plants—cyclones, electrostatic precipitators, fabric filters (baghouses), gravel bed filters, and wet scrubbers. The first four types are designed to capture dry LKD, whereas wet scrubbers capture the LKD in the form of sludge.

The chemical composition of LKD varies widely depending on the factors such as chemical characteristics of the limestone or dolomite used, type of kiln used, operating parameters of the kiln, type of fuel used, and the reactivity of the lime produced. Lime companies try to find markets for LKD, if for no other reason than to save disposal costs. Although there are no statistics on the size of the various markets for LKD, significant markets include agricultural liming, acid neutralization, soil stabilization, and as a supplemental source of calcium for portland cement manufacturing. Some plants (for example, Cutler Magner Co.'s Superior, WI, plant) have developed concerted programs and recycle 100% of their LKD, but this level of recycling is the exception rather than the rule.

Consumption

The breakdown of consumption by major end uses (table 4) was as follows: 37% for metallurgical uses, 28% for environmental uses, 21% for chemical and industrial uses, 13% for construction uses, and 1% for refractory dolomite. Consumption increased in the environmental and metallurgical sectors, by 5.7% and 11.1%, respectively, and was essentially unchanged in the construction sector. Consumption in the chemical and industrial sector decreased by 4.9%. Captive lime accounted for less than 8% of consumption and was used mainly in the production of steel in basic oxygen furnaces, sugar refining, magnesia production, and refractories. Almost all data on captive lime consumption, excluding the sugar industry, are withheld to avoid disclosing company proprietary information. As a result, table 4 lists the total quantity and value of lime by end use. End uses with captive consumption are listed in footnote 4 of the table.

Lime supplies were tight in much of the country as consumption increased by nearly 5% in 2004 after an increase of nearly 8% in 2003. Driven by an increase in raw steel production of more than 9% compared with the previous year, demand was particularly strong for dolomitic quicklime, which was reflected in the 22% increase in production. To balance supply with regional demand, more shipments were made over longer distances.

In steel refining, quicklime is used as a flux to remove impurities, such as phosphorus, silica, and sulfur. The steel industry accounted for about 31% of all lime consumed in the United States. The increase in raw steel production in the United States resulted in a 10% increase in lime consumption for iron and steel related uses to 6.19 Mt (6.82 million short tons) compared with 2003. In the steel industry, two types of furnaces are used today—basic oxygen furnaces and electric arc furnaces. Both furnace types are used at integrated steel plants, but only the electric arc furnace is used at minimills. The increase in steel production and the resulting increase in lime consumption were from plants operating electric arc furnaces.

In nonferrous metallurgy, lime is used in the beneficiation of copper ores to neutralize the acidic effects of pyrite and other iron sulfides and to maintain the proper pH in the flotation process. Lime is used to process alumina and magnesia, to extract uranium from gold slimes, to recover nickel by precipitation, and to control the pH of the sodium cyanide solution used to leach gold and silver from the ore. Such leaching processes are called dump leaching when large pieces of ore are involved, heap leaching when small pieces of ore are involved, and carbon-in-pulp cyanidation when the ore is leached in agitated tanks. Dump and heap leaching involve crushing the ore, mixing it with lime for pH control and agglomeration, and stacking the ore in heaps for treatment with cyanide solution. Lime is used to maintain the pH of the cyanide solution at a level between 10 and 11 to maximize the recovery of precious metals and to prevent the creation of hydrogen cyanide. Lime consumed for these various uses is included in table 4 under the category "Nonferrous metallurgy." Lime usage in nonferrous metallurgy (aluminum and bauxite processing, concentration of copper and gold ores, and magnesium production) increased by nearly 16% in 2004. The amount of the increase was about equally divided between ore concentration and aluminum and bauxite processing, but statistically the increase in consumption for aluminum and bauxite processing was much more impressive (up 48% compared with 2003).

In response to projected production shortfalls, Phelps Dodge Corp. increased output in the second half of 2004 at its Bagdad and Sierrita copper mines in Arizona and resumed concentrate production at its Chino Mine in New Mexico (closed in 2001). Other domestic increases resulted from a full year of operation of the Continental Mine in Montana and startup under new ownership of the Robinson Mine in Nevada in the fourth quarter (Robinson had last operated in 1999). These increases were partially offset by reductions at other operations (Edelstein, 2005). According to USGS figures, the domestic copper industry reported a 9.5% increase in the recovery of copper concentrates, while U.S. mine recovery of gold decreased by about 6% (Edelstein, 2005§; George, 2005§). The increased use of lime for ore concentration appears to have been for copper recovery.

Environmentally, lime is used to treat the tailings that result from the recovery of precious metals such as gold and silver. These tailings may contain elevated levels of cyanides, and lime is used to recover cyanides in such treatment processes as alkaline chlorination, Caro's acid (H_2SO_5), Cyanisorb™, and sulfur dioxide/air.

In the environmental sector, lime is used in the softening and clarification of municipal potable water and to neutralize acid-mine drainage and industrial discharges. In sewage treatment, the traditional role of lime is to control pH in the sludge digester, which removes dissolved and suspended solids that contain phosphates and nitrogen compounds. Lime also aids clarification and in destroying harmful bacteria. More recently, the leadinguse in sewage treatment has been to stabilize the resulting sewage sludge. Sewage sludge stabilization, also called biosolids stabilization, reduces odors, pathogens, and putrescibility of the solids. Lime stabilization involves mixing quicklime with the sludge to raise the temperature and pH of the sludge to minimum levels for a specified period of time. Lime consumption for all sludge treatment was essentially unchanged compared with that of 2003.

In flue gas desulfurization (FGD) systems serving coal-fired powerplants, incinerators, and industrial plants, lime is injected into the flue gas to remove acidic gases, particularly sulfur dioxide (SO_2) and hydrogen chloride (HCl). It also may be used to stabilize the resulting sludge before disposal. Many FGD systems at powerplants are now designed to produce byproduct gypsum from the SO_2 emissions suitable for use in manufacturing gypsum wallboard. Hydrated lime may be used in another FGD-related market—to control sulfur trioxide (SO_3) emissions from selective catalytic reduction (SCR) systems installed at powerplants to control nitrogen oxides (NO_x) emissions.

In 2004, the overall FGD market increased by 240,000 t, or 7% compared with 2003. Consumption in the utility powerplant market actually increased by 280,000 t, but consumption in the much smaller incinerator and industrial boiler markets decreased. In general, two factors were behind the increased consumption of lime in the utility powerplant FGD market—higher natural gas prices and higher prices for SO_2 emission allowances. According to data from the U.S. Department of Energy, Energy Information Administration (2005§), the average price of natural gas to the electric power industry in 2004 increased by about 10% compared with the previous year. This resulted in powerplants switching from natural gas to coal, which required more scrubbing to control SO_2 emissions. In addition, a shortage of low-sulfur Appalachian coal forced some powerplants to switch to higher sulfur coal and to purchase emission allowances to offset the increased SO_2 emissions, which resulted in a tripling in the price of emission allowances to between $600 and $700 per ton. As part of title IV of the Clean Air Act Amendments of 1990, an emission allowance permits a powerplant to emit 1 ton of SO_2 during operation of the powerplant, and it needs to have adequate allowances to match its emissions. If the utility company has insufficient allowances, it has three basic options—switch to a low-sulfur fuel (assuming it is possible or practical), operate its FGD scrubbers for longer periods, or acquire additional emission allowances. Because low-sulfur Appalachian coal was not readily available and emission allowance prices had increased dramatically, utilities chose to increase the use of FGD scrubbers at some powerplants.

Lime is used by the pulp and paper industry in the basic Kraft pulping process where wood chips and an aqueous solution (called liquor) of sodium hydroxide and sodium sulfide are heated in a digester. The cooked wood chips (pulp) are discharged under pressure along with the spent liquor. The pulp is screened, washed, and sent directly to the paper machine or for bleaching. Lime is sometimes used to produce calcium hypochlorite bleach for bleaching the paper pulp. The spent liquor is processed through a recovery furnace where dissolved organics are burned to recover waste heat, sodium sulfide, and sodium carbonate. The recovered sodium sulfide and sodium carbonate are diluted with water and then treated with slaked lime to recausticize the sodium carbonate into sodium hydroxide (caustic soda) for reuse. The byproduct calcium carbonate is recalcined in a lime kiln to recover lime for reuse. The paper industry also uses lime as a coagulant aid in the clarification of plant process water.

According to the American Forest & Paper Association's (AF&PA) annual survey of paper, paperboard, and pulp capacity, U.S. paper and paperboard capacity stabilized in 2004 after 3 consecutive years of decline (Paper Age, 2005§). U.S. printing and writing paper shipments (through November 2004) increased by more than 4% compared with the same period in 2003 (Cody, 2005§). The stabilization of capacity and the increase in paper shipments were reflected by an increase in consumption of lime used for paper and pulp of about 4%.

Lime is used to make precipitated calcium carbonate (PCC), a specialty filler used in premium-quality coated and uncoated papers, paint, and plastics. The most common PCC production process used in the United States is the carbonation process. Carbon dioxide is bubbled through milk-of-lime to form a precipitate of calcium carbonate and water. The reaction conditions determine the size and shape of the resulting PCC crystals. Lime use for PCC production decreased by about 2% compared with the revised 2003 figure, which had previously included 101,000 t that should have been applied to sugar production.

Lime is used, generally in conjunction with soda ash, for softening plant process water. This precipitation process removes bivalent soluble calcium and magnesium cations (and to a lesser extent ferrous iron, manganese, strontium, and zinc) that contribute to the hardness of water. This process also reduces carbonate alkalinity and total dissolved solids.

The chemical industry uses lime in the manufacture of alkalis. Quicklime is combined with coke to produce calcium carbide, which is used to make acetylene and calcium cyanide. Lime is used to make calcium hypochlorite, citric acid, petrochemicals, and other chemicals.

In sugar refining, milk-of-lime is used to raise the pH of the product stream, precipitating colloidal impurities. The lime itself is then removed by reaction with carbon dioxide to precipitate calcium carbonate. The carbon dioxide is obtained as a byproduct of lime production.

In road paving, hydrated lime is used in hot-mix asphalt to act as an antistripping agent. Stripping is generally defined as a loss of adhesion between the aggregate surface and the asphalt cement binder in the presence of moisture. Lime also is used in cold in-place recycling for the rehabilitation of distressed asphalt pavements. Existing asphalt pavement is pulverized by using a milling machine, and a hot lime slurry is added along with asphalt emulsion. The cold recycled mix is placed and compacted by conventional paving equipment, which produces a smooth base course for the new asphalt surface. In 2004, sales of lime for use in asphalt increased by nearly 9% compared with those of 2003.

In construction, hydrated lime and quicklime are used to stabilize fine-grained soils in place of materials that are employed as subbases, such as hydraulic clay fills or otherwise poor-quality clay and silty materials obtained from cuts or borrow pits. Lime also is used in base stabilization, which includes upgrading the strength and consistency properties of aggregates that may be judged unusable or marginal without stabilization. Common applications for lime stabilization included the construction of roads, airfields, building foundations, earthen dams, and parking areas. Lime sales for soil stabilization decreased slightly from the record high achieved in 2003.

In the traditional building sector, quicklime is used to make calcium silicate building products, such as sand-lime brick and autoclaved aerated concrete, which has the advantage of producing building materials that can be cut, drilled, and nailed like wood but otherwise possess qualities similar to regular concrete products.

Hydrated lime is used in the traditional building sector where it is still used in plaster, stucco, and mortars to improve durability. The amount of hydrated lime used for the traditional building markets was essentially unchanged in 2004. A small amount of hydrated lime also is used on the renovation of old structures built with lime-based mortars, which was standard before the development of portland cement-based mortars. Modern portland cement-based mortars are incompatible with old lime mortars. Hydrated lime also is used to make synthetic hydraulic lime, which is produced by blending powdered hydrated lime with pulverized pozzolanic or hydraulic materials.

Dead-burned dolomite, also called refractory lime, is used as a component in tar-bonded refractory brick or monolithic manufacture used in basic oxygen furnaces. This brick also is used in the refractory lining of many treatment and casting ladles, in argon oxygen decarburization and vacuum oxygen decarburization converters, in electric arc furnaces, and in continuous steel casting. Although the actual numbers are rounded to one significant figure to avoid disclosing company proprietary data, the production of dead-burned dolomite increased by about 8% in 2004. LWB Refractories Co. and Carmeuse Lime were the only producers. Hydrated lime is used to produce silica refractory brick used to line industrial furnaces.

Prices

The average values per ton for the various types of lime, rounded to three significant figures, are listed in table 8. The values are reported in dollars per metric ton and dollars per short ton. All value data for lime are reported by type of lime produced—high-calcium quicklime, high-calcium hydrate, dolomitic quicklime, dolomitic hydrate, and dead-burned dolomite. Emphasis is placed on the average value per metric ton of lime sold.

Prices rose significantly in 2004, because of increased demand and the continuing effects of higher production costs. Prices increased for every type of lime; the average for all types of lime sold increased by 5% to $68.20 per metric ton ($61.90 per short ton). Higher prices for kiln fuels (especially coal and natural gas) and transportation fuels (mainly diesel) and increased costs for environmental compliance, labor, and health care have all contributed to higher lime production costs. The steep rise in natural gas prices in recent years resulted in the industry switching almost entirely to coal and coke for firing kilns, but coal prices are up also, and coal is in tight supply. Announced price increases for lime have been successful, but in most cases, they have only compensated for increased energy costs.

Foreign Trade

The United States exported and imported quicklime, hydrated lime (slaked lime), hydraulic lime, and calcined dolomite (dolomitic lime). Combined exports of lime (table 6) were 99,600 t (110,000 short tons) valued at $14.2 million, with about 92% exported to Canada, about 5% exported to Mexico, and the remaining 3% going to various other countries. Combined imports of lime (table 7) were 232,000 t valued at $25.9 million, with 68% from Canada, 31% from Mexico, and the remaining 1% from various countries.

There is some confusion on what is being reported as imports and exports of hydraulic lime. Natural hydraulic lime is produced from siliceous or argillaceous limestones that contain varying amounts of silica, alumina, and iron. There is no production of natural hydraulic lime in the United States. Synthetic hydraulic lime is produced by mixing hydrated lime with pozzolanic or hydraulic materials such as portland cement. Exports could be synthetic hydraulic lime or, because the chemistry is quite similar, portland cement (or some other hydraulic cement product).

No tariffs are placed on imports of hydraulic lime, quicklime, and slaked lime from countries with normal trade relations (NTR) with the United States. There is a 3% ad valorem tariff on imports of calcined dolomite from NTR countries.

Outlook

High energy prices and rising interest rates are expected to slow the growth of the domestic economy. This will negatively affect the domestic steel industry, and it is highly unlikely that there will be significant growth in steel production in 2005 (certainly not the 9.5% increase reported in 2004). The steel industry has reorganized in recent years and become much more efficient and competitive, but it is still vulnerable to developments in world steel markets. Many foreign governments are supporting a substantial increase in steel production capacity equivalent to nearly a 25% increase of world capacity during the next 5 years. These subsidies could contribute to excess steel capacity if world steel demand decreases significantly (Considine, 2005§). Lime demand for steel should remain strong, especially for dolomitic quicklime, but if steel production deceases in response to a slowing economy, lime consumption for steel also will decrease.

The ore concentration market should be bolstered by Phelps Dodge's increasing production of copper concentrates and operations in Arizona and New Mexico. Domestic production of copper concentrates is forecast to increase by more than 30% during the next 2 years (D.L. Edelstein, U.S. Geological Survey, written commun., April 29, 2005). This increase is expected to boost lime sales in the Southwest.

The currently in-place acid rain program (Clean Air Act Amendments) and the clean air interstate rule (finalized March 10, 2005), which covers 28 Eastern States and the District of Columbia and calls for further additional reductions in SO_2 and NO_x emissions, are expected to lead to installation of FGD scrubbers on as much as 49 gigawatts of powerplant capacity by 2010. In addition, current regulations covering emissions from small municipal incinerators and waste-to-energy incinerators, and the standards the U.S. Environmental Protection Agency (EPA) is required to develop for control of hazardous air pollutants from various industrial categories also provide significant opportunities for growth in lime's FGD market. Major areas of complexity and uncertainty, however, involve SO_2 emission allowance trading (their availability and cost), the resultant timing of FGD equipment installations, and competition with limestone-based scrubbing systems. Increased hydrate sales are expected for the control of SO_3 emissions from SCR-NO_x control systems at powerplants.

Federal funding for transportation projects, such as highway construction, makes up the bulk of funding for such projects. The Transportation Equity Act for the 21st Century (TEA-21) was enacted June 9, 1998, as Public Law 105-178. TEA-21 authorized the Federal surface transportation programs for highways, highway safety, and transit for the 6-year period from 1998 to 2003. TEA-21 expired in 2003, and the current extension expires May 31, 2005. As of the end of April 2005, Congress and the Administration had not yet agreed on new funding levels, but reauthorization of TEA-21 is expected most likely at a total funding level between $280 billion and $290 billion. This would essentially be a continuation of previous funding levels and will at least provide stability for planning and commissioning of highway transportation projects through 2008. Lime's road stabilization and hot-mix asphalt markets will not receive the big boost that higher funding levels might have provided, but current funding levels will support a continuation of current lime stabilization and hot-mix asphalt sales. Growth in this sector, therefore, will depend more on expansion into States or regions where lime's use is not common.

The AF&PA's survey suggests the domestic paper industry's capacity to produce paper and paperboard will expand during the next 3 years (2005-07) although at very subdued rates averaging just 0.3% a year. Capacity growth, by comparison, averaged 2.2% a year during the 1990s (Paper Age, 2005§). As a result, lime consumption in the paper and pulp market is expected to be relatively stable during the next few years.

The domestic industry is operating at a high utilization rate, and although there are several lime plants that were shut down or idled in recent years, most are unlikely to restart because of economics or permitting problems. A number of lime companies (large and small) are looking at adding capacity in the next 2 to 3 years, but much depends on the permitting process. Some of the planned capacity is located in nonattainment areas for various air pollutants, and this makes getting the necessary new source review (NSR) permits from the EPA much more difficult. To obtain an NSR permit in an nonattainment area, an applicant must apply the lowest achievable emissions rate technology, obtain emissions offsets from other sources, certify that all other major stationary sources owned by the applicant in the State are complying with all applicable requirements of the Clean Air Act, and provide an analysis of the benefits of the source and the environmental and social costs of the project.

Overall, lime demand is expected to remain strong in 2005, but much depends on how the economy performs, especially with respect to the steel market. The FGD market is expected to demonstrate long-term growth, and the ore concentration market is expected to expand during the next couple of years driven by increased copper production. With lime supplies tight and costs still increasing, prices are expected to continue moving upward.

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TABLE 1
SALIENT LIME STATISTICS[1]

(Thousand metric tons[2] and thousand dollars unless otherwise specified)

	2000	2001	2002	2003	2004
United States[3]					
Number of plants[4]	106	103	99	96	94
Sold or used by producers:					
Quicklime:					
High-calcium	14,300	13,600	13,400	13,900	14,200
Dolomitic	3,000	2,580	2,420	2,460	2,990
Total	17,300	16,200	15,800	16,400	17,200
Hydrated lime:					
High-calcium	1,550	2,030	1,500	2,140	2,300
Dolomitic	421	447	431	464	337
Total	1,970	2,470	1,930	2,610	2,640
Dead-burned dolomite[5]	200	200	200	200	200
Grand total:					
Quantity	19,500	18,900	17,900	19,200	20,000
Value[6]	1,180,000	1,160,000	1,120,000	1,240,000	1,370,000
Average value dollars per metric ton	60.60	61.30	62.60	64.80 r	68.20
Lime sold	17,500	17,000	16,500	17,700	18,500
Lime used	2,020	1,840	1,340	1,470 r	1,540
Exports:[7]					
Quantity	73	96	106	98	100
Value	9,960	11,900	13,100	13,700	14,200
Imports for consumption:[7]					
Quantity	113	115	157	202	232
Value	13,500	15,100	19,700	22,500	25,900
Consumption, apparent[8]	19,600	18,900	17,900	19,300	20,200
World, production	121,000 r	121,000 r	119,000 r	124,000 r	126,000 e

[e]Estimated. [r]Revised.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]To convert metric tons to short tons, multiply metric tons by 1.102.
[3]Excludes regenerated lime; includes Puerto Rico.
[4]Includes producer-owned hydrating plants not located at lime plants.
[5]Data are rounded to no more than one significant digit to protect company proprietary data.
[6]Selling value, free on board plant, excluding cost of containers.
[7]Source: U.S. Census Bureau.
[8]Defined as sold or used plus imports minus exports.

TABLE 2

LIME SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE[1, 2]

State	Plants[3]	Hydrated (thousand metric tons)[4]	Quicklime[5] (thousand metric tons)[4]	Total (thousand metric tons)[4]	Value (thousands)
2003:					
Alabama	5	151	2,140	2,290	$151,000
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming	19	304	2,300	2,600	167,000
California, Oregon, Washington	8	61	240	301	29,300
Illinois, Indiana, Missouri	8	462	3,250	3,710	236,000
Iowa, Nebraska, South Dakota	3	W	W	363	24,600
Kentucky, Tennessee, West Virginia	5	118	2,400	2,520	148,000
Ohio	8	127	1,760	1,880	114,000
Pennsylvania	6	184	1,000	1,190	90,100
Texas	5	638	989	1,630	110,000
Wisconsin	4	169	589	757	46,000
Other[6]	25	393 r	1,910	1,940	128,000
Total	96	2,610	16,600	19,200	1,240,000
2004:					
Alabama	5	165	2,120	2,280	164,000
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming	18	299	2,340	2,640	168,000
California, Oregon, Washington	8	87	291	378	33,200
Illinois, Indiana, Missouri	8	465	3,350	3,820	264,000
Iowa, Nebraska, South Dakota	3	W	W	367	25,500
Kentucky, Tennessee, West Virginia	5	127	2,710	2,830	176,000
Ohio	7	105	1,770	1,880	127,000
Pennsylvania	6	171	1,050	1,220	100,000
Texas	5	630	996	1,630	115,000
Wisconsin	4	181	670	850	53,900
Other[6]	25	409	2,100	2,140	142,000
Total	94	2,640	17,400	20,000	1,370,000

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."

[1]Excludes regenerated lime.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

[3]Includes producer-owned hydrating plants not located at lime plants.

[4]To convert metric tons to short tons, multiply metric tons by 1.102.

[5]Includes dead-burned dolomite.

[6]Includes Arkansas, Florida, Georgia, Louisiana, Massachusetts, Michigan, Minnesota, North Dakota, Oklahoma, Puerto Rico, Virginia, and data indicated by the symbol W.

TABLE 3

LIME SOLD AND USED BY PRODUCERS IN THE UNITED STATES, BY RANGE OF PRODUCTION[1, 2]

	2003			2004		
Range of production	Plants	Quantity (thousand metric tons)[3]	Percentage of total	Plants	Quantity (thousand metric tons)[3]	Percentage of total
Less than 25,000 tons	20 r	224 r	1 r	16	156	1
25,000 to 100,000 tons	24 r	1,120 r	6 r	24	1,030	5
100,000 to 200,000 tons	18 r	2,460 r	13 r	18	2,270	11
200,000 to 300,000 tons	10 r	2,290 r	12 r	10	2,220	11
300,000 to 400,000 tons	9	2,870 r	15 r	11	3,550	18
400,000 to 500,000 tons	7 r	3,260 r	17 r	5	2,310	12
More than 600,000 tons	8 r	6,960 r	36 r	10	8,500	42
Total	96	19,200	100	94	20,000	100

[r]Revised.

[1]Excludes regenerated lime. Includes Puerto Rico.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

[3]To convert metric tons to short tons, multiply metric tons by 1.102.

TABLE 4

LIME SOLD AND USED BY PRODUCERS IN THE UNITED STATES, BY USE[1, 2]

(Thousand metric tons[3] and thousand dollars)

Use	2003 Quantity[4]	2003 Value[5]	2004 Quantity[4]	2004 Value[5]
Chemical and industrial:				
Fertilizer, aglime and fertilizer	65	4,630	33	3,090
Glass	116	7,250	120	8,250
Paper and pulp	774 r	46,500 r	802	51,600
Precipitated calcium carbonate	1,210 r	77,200 r	1,180	82,800
Sugar refining	716 r	42,200 r	707	39,900
Other chemical and industrial[6]	1,600	112,000	1,410	102,000
Total	4,470 r	290,000 r	4,260	287,000
Metallurgical:				
Steel and iron:				
Basic oxygen furnaces	3,620 r	234,000 r	3,070	214,000
Electric arc furnaces	1,590 r	100,000 r	2,690	185,000
Other steel and iron	404	24,700	425	27,500
Total	5,620	359,000	6,190	427,000
Nonferrous metallurgy[7]	1,070	63,600	1,240	75,700
Total	6,690	423,000	7,430	503,000
Construction:				
Asphalt	383	31,800	418	34,600
Building uses	478	48,400	477	49,900
Soil stabilization	1,640	108,000	1,610	110,000
Other construction	13	946	12	1,070
Total	2,510	189,000	2,520	196,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	3,210	180,000	3,490	211,000
Incinerators	150 r	10,700	135	9,990
Industrial boilers and other FGD	75 r	6,610	49	4,070
Total	3,440	197,000	3,680	225,000
Sludge treatment:				
Sewage	252	16,900	200	14,200
Other, industrial, hazardous, etc.	66 r	4,830	116	8,650
Total	318	21,800	316	22,900
Water treatment:				
Acid-mine drainage	112	7,500	102	7,580
Drinking water	886	58,100	869	59,800
Waste water	385	27,100	503	37,300
Total	1,380	92,600	1,470	105,000
Other	167	12,100	143	10,600
Total	5,310	323,000	5,610	363,000
Refractories (dead-burned dolomite)	200 [8]	18,600 [9]	200 [8]	20,700 [9]
Grand total	19,200	1,240,000	20,000	1,370,000

See footnotes at end of table.

TABLE 4—Continued

LIME SOLD AND USED BY PRODUCERS IN THE UNITED STATES, BY USE[1, 2]

[r]Revised.

[1]Excludes regenerated lime. Includes Puerto Rico.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

[3]To convert metric tons to short tons, multiply metric tons by 1.102.

[4]Quantity includes lime sold and used, where "used" denotes lime produced for internal company use for magnesia, paper and pulp, precipitated calcium carbonate, basic oxygen furnaces, mason's lime, and refractories.

[5]The U.S. Geological Survey does not collect value data by end use; the values shown are mainly derived from average lime values.

[6]May include alkalis, calcium carbide and cyanamide, citric acid, food (animal or human), gelatin, oil grease, oil well drilling, tanning, and other uses. Magnesia is included here to avoid disclosing company proprietary data.

[7]Includes aluminum and bauxite, magnesium, ore concentration (copper, gold, etc.) and other.

[8]Data are rounded to one significant digit to protect company proprietary data.

[9]Values are estimated based on average value per metric ton of dead-burned dolomite for each year.

TABLE 5

HYDRATED LIME SOLD OR USED IN THE UNITED STATES, BY END USE[1, 2]

(Thousand metric tons[3] and thousand dollars)

Use	2003 Quantity[4]	2003 Value[5]	2004 Quantity[4]	2004 Value[5]
Chemical and industrial	498	45,400	517	51,600
Construction:				
Asphalt	364	30,600	381	32,200
Building uses	467	47,600	462	49,000
Soil stabilization	516	38,200	510	39,200
Other construction	7	628	8	786
Total	1,350	117,000	1,360	121,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	158	8,540	158	11,500
Incinerators	33	2,910	21	1,910
Industrial boilers and other FGD	43	4,440	22	2,310
Total	234	15,900	202	15,700
Sludge treatment:				
Sewage	35	3,050	39	3,230
Other sludge treatment	35	2,980	43	4,080
Total	70	6,030	82	7,310
Water treatment:				
Acid-mine drainage	73	5,130	62	5,070
Drinking water	163	13,800	153	13,600
Waste water	122	9,880	175	14,900
Total	358	28,900	389	33,600
Other environmental	58	4,730	42	3,620
Metallurgy	36	3,180	43	3,760
Grand total	2,610	221,000	2,640	237,000

[1]Excludes regenerated lime. Includes Puerto Rico.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

[3]To convert metric tons to short tons, multiply metric tons by 1.102.

[4]Quantity includes hydrated lime sold and used, where "used" denotes lime produced for internal company use in building, chemical and industrial, and metallurgical sectors.

[5]The U.S. Geological Survey does not collect value data by end use; the values shown are mainly derived from average lime values.

TABLE 6

U.S. EXPORTS OF LIME, BY TYPE[1]

Type	2003 Quantity (metric tons)[2]	2003 Value[3]	2004 Quantity (metric tons)[2]	2004 Value[3]
Calcined dolomite:				
Canada	21,000	$5,060,000	23,400	$5,610,000
Germany	3,520	395,000	--	--
Mexico	626	156,000	111	32,700
Other[4]	56	13,000	111	54,900
Total	25,200	5,620,000	23,600	5,690,000
Hydraulic lime:				
Bahamas, The	103	19,900	146	32,500
Canada	10,500	1,380,000	6,710	966,000
Mexico	57	10,700	14	12,000
Other[5]	181	88,000	216	97,000
Total	10,900	1,500,000	7,080	1,110,000
Quicklime:				
Bahamas, The	345	64,100	320	66,600
Canada	49,300	4,650,000	55,300	5,040,000
Costa Rica	417	96,600	377	164,000
Korea, Republic of	22	9,020	--	--
Mexico	4,840	615,000	4,310	594,000
Total	55,000	5,440,000	60,300	5,870,000
Slaked lime, hydrate:				
Canada	5,740	907,000	6,030	944,000
Mexico	658	174,000	1,010	259,000
Philippines	338	62,400	181	24,100
Other[6]	105 r	25,300 r	1,330	311,000
Total	6,850	1,170,000	8,550	1,540,000
Grand total	97,800	13,700,000	99,600	14,200,000

[r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]To convert metric tons to short tons, multiply metric tons by 1.102.

[3]Declared free alongside ship valuation.

[4]Includes Finland (2004), Honduras (2003), Japan (2004), Taiwan (2003), and Uruguay (2004).

[5]Includes Colombia (2003), Haiti (2003), Honduras (2004), Japan, and the Philippines (2004), Trinidad and Tobago (2003), and Venezuela (2003).

[6]Includes Honduras, Namibia (2003), the Netherlands (2004), South Africa, Trinidad and Tobago (2004), and the United Kingdom (2004).

Source: U.S. Census Bureau.

TABLE 7

U.S. IMPORTS FOR CONSUMPTION OF LIME, BY TYPE[1]

	2003		2004	
Type	Quantity (metric tons)[2]	Value[3]	Quantity (metric tons)[2]	Value[3]
Calcined dolomite:				
Canada	9,910	$833,000	21,600	$2,120,000
Mexico	453	60,400	538	66,700
Other[4]	506	161,000	158	69,100
Total	10,900	1,050,000	22,300	2,250,000
Hydraulic lime:				
Canada	70	8,580	4	2,100
Mexico	3,430	391,000	4,440	489,000
Other[5]	1,440	417,000	746	378,000
Total	4,940	817,000	5,190	869,000
Quicklime:				
Canada	109,000	14,600,000	127,000	16,400,000
Mexico	57,700	3,150,000	47,000	2,760,000
Other[6]	154 r	299,000	262	126,000
Total	166,000	18,000,000	174,000	19,200,000
Slaked lime, hydrate:				
Canada	8,760	905,000	9,200	976,000
Mexico	11,000	1,290,000	20,400	2,240,000
Other[7]	489	349,000	354	287,000
Total	20,200	2,540,000	30,000	3,500,000
Grand total	202,000	22,500,000	232,000	25,900,000

[r]Revised.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]To convert metric tons to short tons, multiply metric tons by 1.102.

[3]Declared cost, insurance, and freight valuation.

[4]Includes China, Germany (2003), and Spain.

[5]Includes Belgium (2004), the Dominican Republic, France, Germany (2004), Italy, and Switzerland.

[6]Includes Australia, Belgium (2004), Brazil (2004), China, Finland (2003), Japan, Norway (2003), Saudi Arabia (2004), Sweden (2004), and the United Kingdom (2003).

[7]Includes Belgium, Brazil, China (2003), France (2004), Germany, Italy, Japan, and the United Kingdom.

Source: U.S. Census Bureau.

TABLE 8

LIME PRICES[1]

Type	2003 Dollars per metric ton	2003 Dollars per short ton[2]	2004 Dollars per metric ton	2004 Dollars per short ton[2]
Sold and used:				
Quicklime	61.40 r	55.70	64.80	58.80
Hydrate	84.80	77.00	89.80	81.40
Dead-burned dolomite	90.80	82.30	93.80	85.10
Average all types	64.90	58.80	68.40	62.10
Sold:				
High-calcium quicklime	61.00	55.40	63.90	55.00
Dolomite quicklime	62.10	56.30	67.20	61.00
Average quicklime	61.20	55.50	64.50	58.50
High-calcium hydrate	81.20	73.70	87.20	79.10
Dolomite hydrate	102.70	93.20	109.50	99.40
Average hydrate	84.90	77.00	89.90	81.50
Dead-burned dolomite	92.10	83.50	97.50	88.50
Average all types	64.80	58.80	68.20	61.90

[r]Revised.

[1]Average value per ton, on a free on board plant basis, including cost of containers.

[2]Conversions were made from unrounded metric ton values and are rounded to no more than three significant digits.

TABLE 9

QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Thousand metric tons)

Country[3]	2000	2001	2002	2003	2004[e]
Australia[e]	1,500	1,500	1,500	1,500	1,500
Austria[e]	2,000	2,000	2,000	2,000	2,000
Belgium[e, 4]	2,300 r	2,000 r	2,000 r	2,000 r	2,000
Brazil	6,273	6,300	6,500 e	6,500 e	6,500
Bulgaria	1,388	2,025	1,136 r	2,902 r	2,900
Canada	2,525	2,213	2,248 r	2,216 r	2,200
Chile[e]	1,000	1,000	1,000	1,000	1,000
China[e]	21,500	22,000	22,500	23,000	23,500
Colombia	1,300	1,300	1,300	1,300 e	1,300
Czech Republic	1,202	1,300 e	1,120 e	1,263 r	1,300
Egypt[e]	800	800	800	800	800
France[e, 4]	3,100 r	3,000 r	3,000 r	3,000 r	3,000
Germany	6,850	6,630 r	6,620 r	6,637 r	6,700
India[e]	910	910	900	900	900
Iran[e]	2,200	2,000	2,200	2,200	2,200
Italy[e, 5]	3,500	3,500	3,000	3,000	3,000
Japan, quicklime only	8,106	7,586	7,420	7,953 r	7,950
Mexico[e, 4]	5,300 r	4,800 r	5,100 r	5,700 r	5,700
Poland	2,376	2,049	1,960	1,955 r	1,950
Romania	1,480	1,790	1,829	2,025 r	2,000
Russia[e]	8,000	8,000	8,000	8,000	8,000
Slovakia	750	816	912	847	850
Slovenia	150 e	1,434	1,636	1,500	1,500
South Africa, burnt lime sales	1,391	1,615	1,598	1,600 e	1,500
Spain[e, 4]	1,700 r	1,700 r	1,800 r	1,800 r	1,800
Taiwan[e]	800	800	750	800	800
Turkey[e, 4]	3,300 r	3,200 r	3,300 r	3,300 r	3,400
United Kingdom[e]	2,500	2,500	2,000	2,000	2,000
United States, including Puerto Rico, sold or used by producers	19,500	18,900	17,900	19,200	20,000 [6]
Vietnam	1,156	1,351 r	1,426 r	1,450 r, e	1,500
Other[e]	6,080 r	5,890 r	5,900 r	5,700 r	5,700
Total	121,000 r	121,000 r	119,000 r	124,000 r	126,000

[e]Estimated. [r]Revised.

[1]World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through April 1, 2005.

[3]In addition to the countries listed, Argentina, Iraq, Pakistan, Syria, and several other nations produce lime, but output data are not reported; available general information is inadequate to formulate reliable estimates of output levels.

[4]Sales only; data may be incomplete.

[5]Includes hydraulic lime.

[6]Reported figure.